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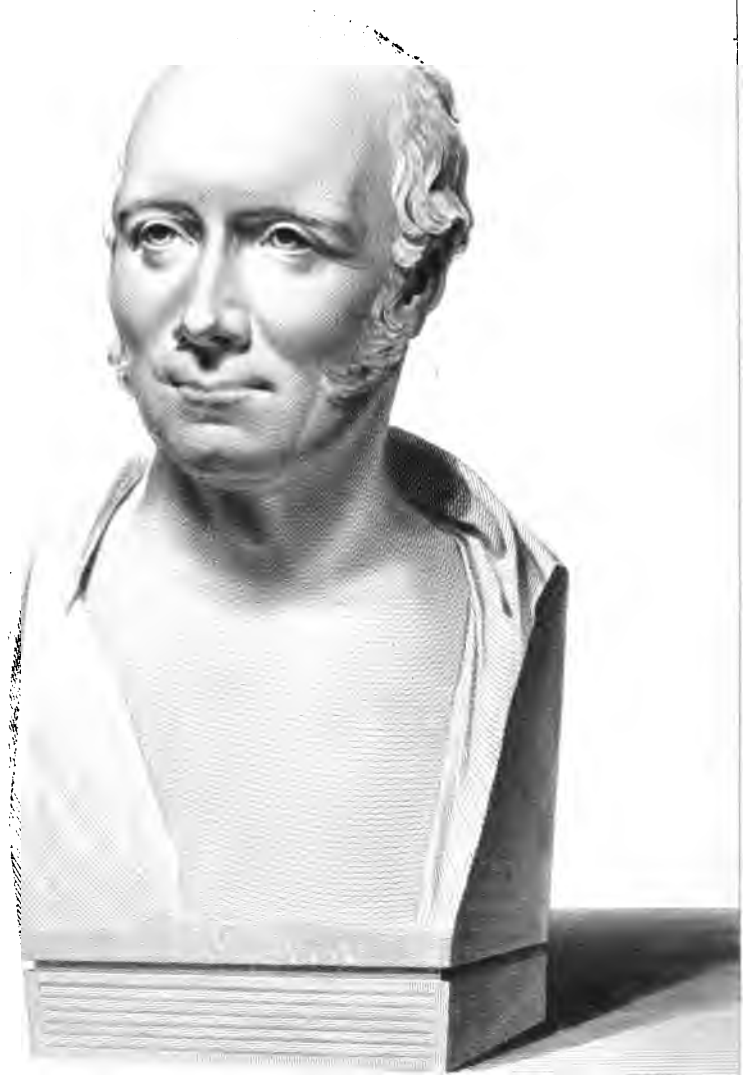
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*John H. Gladstone.*

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WILLIAM SHAKESPEARE F.R.S.E.

1564-1616





# Biographical Sketch

of the late

## Robert Stevenson

F.R.S.E. M.W.S. F.G.S.L. M.I.C.E. ETC. ETC.

CIVIL ENGINEER

BY

ALAN STEVENSON, LL.B. F.R.S.E.



READ AT THE ROYAL SOCIETY OF EDINBURGH, AT THE MEETING  
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44







## BELL ROCK LIGHTHOUSE



Drawn by Miss Svenson.

Engraved by J. Horsburgh.

*Pharos loquax*  
Far in the bosom of the deep  
O'er these wild shelves my watch I keep  
A steadily gem of change-ful light  
Bound on the dusky brow of Night  
The seaman bids my lustre hail  
And scorns to strike his hivers sail





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## BIOGRAPHICAL SKETCH.



ROBERT STEVENSON was born at Glasgow on the 8th June 1772, and died at Edinburgh on the 12th July 1850, in the seventy-ninth year of his age. His father, Alan Stevenson, was a partner in a West India House in Glasgow, and died in the island of St Christopher, while on a visit to his brother, who managed the business abroad. His only son Robert, the subject of this memoir, was then an infant, and, with his mother, was ultimately left in circumstances of the greatest difficulty; for the same epidemic fever which deprived him of his father carried off his uncle also, at a time when his loss operated most disadvantageously on the business which he had superintended, and very many years elapsed before any funds in which my father had an interest were realised. His mother's circumstances now compelled her to take advantage of a charity school for him during his infancy; and the high spirit of the man is well brought out by the fact that he devoted his first earnings in life, at the

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Cumbræ Lighthouse, to the repayment to that institution of what he viewed as a debt. In this manner was my father's early education conducted, although, as the sequel shows, with success, yet under circumstances which could not by any means be called favourable. This success was chiefly due to the energy of his mother, Jane Lillie, who was a woman of great prudence and remarkable fortitude, based on deep convictions of religion. It appears, from some memoranda left by my father for the information of his family, that his mother had intended him for the ministry, with a view to which he had been sent to the school of a famous linguist of his day, Mr Macintyre. Circumstances, however, occurred which entirely changed his prospects and pursuits. Soon after he had attained his fifteenth year, his mother was married to Mr Thomas Smith, who had commenced life as a tinsmith and lampmaker in Edinburgh, and who, being an ingenious mechanician, afterwards directed his attention to the subject of lighthouses. So successful were Mr Smith's endeavours to improve the mode of illumination, by substituting oil lamps with parabolic mirrors for the open coal-fires which formerly served for beacons to the mariner, that his improvements attracted the notice of Professor Robison and Sir David Hunter Blair, and he was appointed engineer to the Northern Lighthouse Board, immediately after its constitution by the Act of 1786. In these pursuits my father had rendered himself useful to Mr Smith, who intrusted him, at the early age of nineteen, with the superin-

tendence of the erection of a lighthouse on the island of Little Cumbrae in the river Clyde, according to a plan which Mr Smith had furnished to the Trustees for the Clyde Navigation. This connection soon led to his adoption as Mr Smith's partner in business, and in 1799 to his marriage with his eldest daughter; and as the entire management of the lighthouse business had already for some years, with the concurrence of the Board, devolved upon him, he naturally succeeded Mr Smith as engineer, an office which he resigned in 1843, after having fulfilled its arduous duties for about half a century.

During the cessation of the works at Cumbrae in winter, Mr Stevenson, who, even at that time, had determined to follow out the profession of a civil engineer, and had begun to feel the want of systematic training, applied himself, it appears, with great zeal to the practice of surveying and architectural drawing, and to the study of the mathematical and physical sciences, at the Andersonian Institution at Glasgow. Of the kindness of Dr Anderson, who presided over that institution, he ever entertained a most grateful remembrance, and often spoke of him as one of his best advisers and kindest friends. In the manuscript memoranda already noticed, he thus records his obligations to him. It was "the practice of Professor Anderson kindly to befriend and forward the views of his pupils; and his attention to me, during the few years I had the pleasure of being known to him, was of a very marked kind, for he directed my

attention to various pursuits, with the view to my coming forward as an engineer."

After completing the Cumbrae Lighthouse, he was engaged under Mr Smith in erecting lighthouses on the Pentland Skerries in Orkney, in returning from whence, in 1794, he made a narrow escape from shipwreck in the sloop Elizabeth of Stromness. The Elizabeth had proceeded as far as Kinnaird Head on her southward voyage, and was then becalmed when within about three miles of the shore. The captain kindly landed my father, who continued his journey to Edinburgh by land. A very different fate, however, awaited his unfortunate shipmates. A violent gale came on, which drove the Elizabeth back to Orkney, where she was totally wrecked, and all on board perished!

Notwithstanding his active duties in summer, he was so zealous in the pursuit of knowledge that he contrived, during several successive winters, on his return from Orkney, to attend the philosophical classes at the University of Edinburgh. In this manner he attended Professor Playfair's second and third mathematical courses, two sessions of Professor Robison's natural philosophy, two courses of chemistry under Dr Hope, and two of natural history under Professor Jameson. To these he added a course of moral philosophy under Dugald Stewart, and also a course of logic, and one of agriculture. "I was prevented, however," he remarks, in the manuscript memoranda, "from taking my degree of M.A. by my slender knowledge of Latin, in which my highest book



was the *Oration of Cicero*, and by my total want of Greek." Such zeal in the pursuit of knowledge under so many discouragements, and views so enlarged of the benefits and value of a liberal education, were characteristics of a mind of no ordinary vigour.

The most important work of Mr Stevenson's life is the Bell Rock Lighthouse. Of the progress of that great undertaking he has left a lasting memorial and most interesting narrative in his "Account," a quarto volume of upwards of 500 pages, which was written to his dictation by his only daughter. But there are some circumstances connected with the early history of that work which, while they could not properly have found a place in his own narrative, have been noticed in the above-mentioned manuscript memoranda, from which I shall transcribe a few paragraphs detailing his early efforts and disappointments whilst designing that lighthouse :—

"All knew the difficulties of the erection of the Eddystone Lighthouse, and the casualties to which that edifice had been liable ; and in comparing the two situations, it was generally remarked that the Eddystone was barely covered by the tide at *high water*, while the Bell Rock was barely uncovered at *low water*.

"I had much to contend with in the then limited state of my experience ; and I had in various ways to bear up against public opinion as well as against interested parties. I was in this state of things, however, greatly supported, and I would even say often comforted, by Mr Clerk of Eldin, author of the *System of Breaking the Line in Naval Tactics*. Mr Clerk took great interest in my models, and spoke much of them in scientific circles—he carried men of science and eminent strangers to the model-room which I had provided in Merchants' Hall, of which he sometimes carried the key, both when I was at home and while I was abroad. He introduced me to Lord Webb Seymour,

to Admiral Lord Duncan, and to Professors Robison and Playfair, and others. Mr Clerk had been personally known to Smeaton, and used occasionally to speak of him to me."

It is impossible to read this little narrative without feeling a respect for Mr Clerk's hearty enthusiasm, and perceiving the beneficial influence which a kindly disposition, when thus united with an active and inventive mind like his, is calculated to produce on the prospects and pursuits of a young man, by stimulating an honourable emulation and discouraging a desponding spirit.

"But at length," the memorandum continues, "all difficulties with the public as well as with the better informed few, were dispelled by the fatal effects of a dreadful storm from the N.E., which occurred in December 1799, when it was ascertained that no fewer than seventy sail of vessels were stranded or lost, with many of their crews, upon the coast of Scotland alone! Many of them, it was not doubted, might have found a safe asylum in the Firth of Forth, had there been a lighthouse upon the Bell Rock, on which, indeed, it was generally believed the York, of 74 guns, with all hands, perished, none being left to tell the tale! The coast for many miles exhibited portions of that fine ship. There was now, therefore, but one voice,—'There must be a lighthouse erected on the Bell Rock.'

"Previous to this dreadful storm I had prepared my pillar-formed model, a section of which is shown in Plate VII. of the *Account of the Bell Rock Lighthouse*. Early in the year 1800, I for the first time landed on the rock to see the application of my model to the situation for which it was designed and made. On this occasion I was accompanied by my friend Mr James Haldane, architect, whose pupil I had been for architectural drawing. Our landing was at low water of a spring-tide, when a good *space* of rock was above water, and then the realities of its danger were amply exemplified by the numerous relics which were found in its crevices, such as a ship's marking-iron, a piece of a kedge-anchor and a cabin stove, a bayonet, cannon-ball, silver shoebuckle, crowbars, pieces of money, and other evidences of recent shipwreck. I had no sooner set foot upon the

rock than I laid aside all idea of a pillar-formed structure, fully convinced that a building on similar principles with the Eddystone would be found practicable.

"On my return from this visit to the rock, I immediately set to work in good earnest with a design of a stone lighthouse, and modelled it. Of this design a section is also given in Plate VII. above noticed. I accompanied this design with a report or memorial to the Lighthouse Board, which I gave in the Appendix of my 'Account' at p. 440. The pillar-formed plan I estimated at £15,000, and the stone building at £42,000.\* But still I found that I had not made much impression on the Board on the score of expense, for they feared it would cost much more than forty or fifty thousand pounds. Here, therefore, the subject rested with the Board for a time.

In order to fortify his views, my father requested the Board to take the advice of Mr Telford, and ultimately of Mr Rennie, who concurred with him in thinking a stone tower practicable. But it appears that still the banks would not advance money on the security, and the Board resolved to apply for an Act of Parliament.

"To the very last the bankers were in doubt as to their security on the dues for so great and hazardous an undertaking; and the bill included an authority to borrow £25,000 from the Exchequer. I attended this bill through Parliament. Mr Rennie and myself were examined; but the only plans and information otherwise before the Committee were those already noticed, which I had laid before the Board in 1800.

"The Lighthouse Act having obtained the royal assent, I began to feel a new responsibility. The erection of a lighthouse on a rock about twelve miles from land, and so low in the water that the foundation-course must be at least on a level with the lowest tide, was an enterprise so full of uncertainty and hazard, that it could not fail to press on my mind. I felt regret that I had not had the opportunity of a greater range of practice to fit me for such an undertaking. But

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\* The actual cost of the tower was £41,000.

I was fortified by an expression of my friend Mr Clerk, in one of our conversations upon its difficulties. 'This work,' said he, 'is unique, and can be little forwarded by experience of ordinary masonic operations. In this case, Smeaton's Narrative must be the text-book, and energy and perseverance *the pratique*.'

Mr Rennie, also, who had been appointed to advise with my father in case of emergency, was not behind in administering comfort, and wrote to him, during the progress of the work, in the following cheering terms: "Poor old fellow" (alluding to the name of Smeaton), "I hope he will now and then take a peep of us, and inspire you with fortitude and courage to brave all difficulties and all dangers, to accomplish a work which will, if successful, immortalise you in the annals of fame."

How well Mr Stevenson met the demands which, in the course of his great enterprise, were made on his perseverance, fortitude, and self-denial, the history of the operations, and their successful completion, abundantly show. The work was, indeed, in all respects, peculiarly suited to his tastes and habits; and Mr Clerk truly, although perhaps unconsciously, characterised the man, in his terse statement of what would be required of him. No one can read his account of the Bell Rock Lighthouse without perceiving the justness of this estimate of his character. His daily cheerful participation in all the toils and hazards which were, for two seasons, endured in the floating light-ship, and afterwards in the timber house or beacon, over which the waves

broke with prodigious force, and caused a most alarming *twisting* movement of its main supports, were proofs not merely of calm and enduring courage, but of great self-denial and enthusiastic devotion to his calling. On one occasion in particular, his fortitude and presence of mind were most severely tried, and well they stood the test. I shall give the narrative of this most interesting adventure in his own words ; but I cannot do so without expressing the regret I have so often felt, that, from some mistaken delicacy, he had been induced throughout his "Account" to speak of himself in the third person as "the writer." This has encumbered the style with artificial phraseology, has damped the ardour of the narrator, and in some instances has led to an awkward ambiguity. The following passage possesses great interest :—

"Soon after the artificers landed they commenced work ; but the wind coming to blow hard, the Smeaton's boat and crew, who had brought their complement of eight men to the rock, went off to examine her riding-ropes, and see that they were in proper order. The boat had no sooner reached the vessel than she went adrift, carrying the boat along with her ; and both had even got to a considerable distance before this situation of things was observed, every one being so intent upon his own particular duty that the boat had not been seen leaving the rock. As it blew hard, the crew, with much difficulty, set the mainsail upon the Smeaton, with a view to work her up to the buoy, and again lay hold of the moorings. By the time that she was got round to make a tack towards the rock, she had drifted at least three miles to leeward, with the praam boat astern ; and having both the wind and tide against her, the writer perceived, with no little anxiety, that she could not possibly return to the rock till long after its being overflowed ; for, owing to the anomaly of the tides, formerly noticed, the Bell Rock is completely under water before the ebb abates to the offing.

“ In this perilous predicament, indeed, he found himself placed between hope and despair ; but certainly the latter was by much the most predominant feeling of his mind,—situate upon a sunken rock, in the middle of the ocean, which, in the progress of the flood-tide, was to be laid under water to the depth of at least twelve feet in a stormy sea. There were this morning in all thirty-two persons on the rock, with only two boats, whose complement, even in good weather, did not exceed twenty-four sitters ; but to row to the floating light with so much wind, and in so heavy a sea, a complement of eight men for each boat was as much as could with propriety be attempted, so that in this way about one-half of our number was unprovided for. Under these circumstances, had the writer ventured to despatch one of the boats, in expectation of either working the Smeaton sooner up towards the rock, or in hopes of getting her boat brought to our assistance, this must have given an immediate alarm to the artificers, each of whom would have insisted upon taking to his own boat, and leaving the eight artificers belonging to the Smeaton to their chance. Of course, a scuffle might have ensued, and it is hard to say, in the ardour of men contending for life, where it might have ended. It has even been hinted to the writer that a party of the *pickmen* were determined to keep exclusively to their own boat against all hazards.

“ The unfortunate circumstance of the Smeaton and her boat having drifted was, for a considerable time, only known to the writer, and to the landing-master, who removed to the further point of the rock, where he kept his eye steadily upon the progress of the vessel. While the artificers were at work, chiefly in sitting or kneeling postures, excavating the rock, or boring with the jumpers, and while their numerous hammers, and the sound of the smith's anvil, continued, the situation of things did not appear so awful. In this state of suspense, with almost certain destruction at hand, the water began to rise upon those who were at work on the lower parts of the sites of the beacon and lighthouse. From the run of sea upon the rock, the forge-fire was also sooner extinguished this morning than usual, and the volumes of smoke having ceased, objects in every direction became visible from all parts of the rock. After having had about three hours' work, the men began, pretty generally, to make towards their respective boats for their jackets and stockings, when, to their astonishment, instead of three they found only two boats, the third being adrift with the Smeaton. Not a word was uttered by any one, but all appeared to be silently calculating their

numbers, and looking to each other with evident marks of perplexity depicted in their countenances. The landing-master, conceiving that blame might be attached to him for allowing the boat to leave the rock, still kept at a distance. At this critical moment, the author was standing upon an elevated part of Smith's Ledge, where he endeavoured to mark the progress of the Smeaton, not a little surprised that the crew did not cut the praam adrift, which greatly retarded her way, and amazed that some effort was not making to bring at least the boat, and attempt our relief. The workmen looked steadfastly upon the writer, and turned occasionally towards the vessel, still far to leeward. All this passed in the most perfect silence, and the melancholy solemnity of the group made an impression never to be effaced from his mind.

"The writer had all along been considering various schemes—providing the men could be kept under command—which might be put in practice for the general safety, in hopes that the Smeaton might be able to pick up the boats to leeward, when they were obliged to leave the rock. He was, accordingly, about to address the artificers on the perilous nature of their circumstances, and to propose that all hands should unstrip their upper clothing when the higher parts of the rock were laid under water; that the seamen should remove every unnecessary weight and encumbrance from the boats; that a specified number of men should go into each boat, and that the remainder should hang by the gunwales, while the boats were to be rowed gently towards the Smeaton, as the course to the Pharos or floating light lay rather to windward of the rock. But when he attempted to speak, his mouth was so parched that his tongue refused utterance, and he now learned by experience that the saliva is as necessary as the tongue itself for speech. He then turned to one of the pools on the rock and lapped a little water, which produced an immediate relief. But what was his happiness when, on rising from this unpleasant beverage, some one called out 'a boat! a boat!' and on looking around, at no great distance, a large boat was seen through the haze making towards the rock. This at once enlivened and rejoiced every heart. The timeous visitor proved to be James Spink, the Bell Rock pilot, who had come express from Arbroath with letters. Spink had for some time seen the Smeaton, and had even supposed, from the state of the weather, that all hands were on board of her, till he approached more nearly and observed people upon the rock. Upon this fortunate change of circumstances

sixteen of the artificers were sent at two trips in one of the boats, with instructions for Spink to proceed with them to the floating light.\* This being accomplished, the remaining sixteen followed in the two boats belonging to the service of the rock. Every one felt the most perfect happiness at leaving the Bell Rock this morning, though a very hard and even dangerous passage to the floating light still awaited us, as the wind by this time had increased to a pretty hard gale, accompanied with a considerable swell of sea. The boats left the rock about nine, but did not reach the vessel till twelve o'clock noon, after a most disagreeable and fatiguing passage of three hours. Every one was as completely drenched in water as if he had been dragged astern of the boats."

The state of suffering and discomfort as well as danger on board the floating light, which lay moored off the rock during the first two seasons of the work, before the timber Beacon was used as a habitation, is described in the following passage, which presents a striking illustration of the continual anxiety that must have existed in the minds of those engaged in the work, and of the frequent calls for energetic and courageous exertion.

"About two o'clock P.M. a great alarm was given throughout the ship, from the effects of a very heavy sea which struck her, and almost filled the waist, pouring down into the berths below, through every chink and crevice of the hatches and skylights. From the motion of the vessel being thus suddenly deadened or checked, and from the flowing in of the water above, it is believed there was not an individual on board who did not think, at the moment, that the vessel had foundered and was in the act of sinking. The writer could withstand this no longer, and as soon as she again began to range to the sea, he determined to make another effort to get upon deck.

"It being impossible to open any of the hatches in the fore part of the ship in communicating with the deck, the watch was changed by

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\* Spink's boat was too large to come close to the rock.



passing through the several berths to the companion-stair leading to the quarter-deck. The writer, therefore, made the best of his way aft, and on a second attempt to look out, he succeeded, and saw indeed an astonishing sight. The seas or waves appeared to be ten or fifteen feet in height of unbroken water, and every approaching billow seemed as if it would overwhelm our vessel, but she continued to rise upon the waves, and to fall between the seas in a very wonderful manner. It seemed to be only those seas which caught her in the act of rising which struck her with so much violence, and threw such quantities of water aft. On deck there was only one solitary individual looking out, to give the alarm in the event of the ship breaking from her moorings. The seaman on watch continued only two hours ; he had no greatcoat nor overall of any kind, but was simply dressed in his ordinary jacket and trousers ; his hat was tied under his chin with a napkin, and he stood aft the foremast, to which he had lashed himself with a gasket or small rope round his waist, to prevent his falling upon deck or being washed overboard. Upon deck everything that was moveable was out of sight, having either been stowed below previous to the gale, or been washed overboard. Some trifling parts of the quarter-boards were damaged by the breach of the sea, and one of the boats upon deck was about one-third full of water, the oyle-hole or drain having been accidentally stopped up, and part of the gunwale had received considerable injury. Although the previous night had been a very restless one, it had not the effect of inducing sleep in the writer's berth on the succeeding one ; for having been so much tossed about in bed during the last thirty hours, he found no easy spot to turn to, and his body was all sore to the touch, which ill accorded with the unyielding materials with which his bed-place was surrounded.

“ This morning about eight o'clock the writer was agreeably surprised to see the scuttle of his cabin skylight removed, and the bright rays of the sun admitted. Although the ship continued to roll excessively and the sea was still running very high, yet the ordinary business on board seemed to be going forward on deck. It was impossible to steady a telescope so as to look minutely at the progress of the waves, and trace their breach upon the Bell Rock, but the height to which the cross-running waves rose in sprays, when they met each other, was truly grand, and the continued roar and noise of the sea was very perceptible to the ear. To estimate the height of the sprays at 40 or 50 feet would surely be within the mark. Those of the workmen

who were not much afflicted with sea-sickness came upon deck, and the wetness below being dried up, the cabins were again brought into a habitable state. Every one seemed to meet as if after a long absence, congratulating his neighbour upon the return of good weather. Little could be said as to the comfort of the vessel; but after riding out such a gale, no one felt the least doubt or hesitation as to the safety and good condition of her moorings. The master and mate were extremely anxious, however, to heave in the hempen cable, and see the state of the clinch or iron ring of the chain-cable. But the vessel rolled at such a rate that the seamen could not possibly keep their feet at the windlass, nor work the handspokes, though it had been several times attempted since the gale took off.

"About twelve noon, however, the vessel's motion was observed to be considerably less, and the sailors were enabled to walk upon deck with some degree of freedom. But to the astonishment of every one it was soon discovered that the floating light was adrift! The windlass was instantly manned, and the men soon gave out that there was no strain upon the cable. The mizzen sail, which was bent for the occasional purpose of making the vessel ride more easily to the tide, was immediately set, and the other sails were also hoisted in a short time, when, in no small consternation, we bore away about one mile to the south-westward of the former station, and there let go the best bower-anchor and cable, in twenty fathoms water, to ride until the swell of the sea should fall, when it might be practicable to grapple for the moorings, and find a better anchorage for the ship.

"As soon as the deck could be cleared the cable-end was hove up, which had parted at the distance of about 50 fathoms from the chain moorings. On examining the cable, it was found to be considerably chafed, but where the separation took place, it appeared to be worn through, or cut shortly off. How to account for this would be difficult, as the ground, though rough and gravelly, did not, after much sounding, appear to contain any irregular parts. It was therefore conjectured that the cable must have hooked some piece of wreck, as it did not appear from the state of the wind and tide that the vessel could have fouled her anchor when she veered round with the wind, which had shifted in the course of the night from N.E. to N.N.W.

"Be this as it may, it was a circumstance quite out of the power of man to prevent, as, until the ship drifted, it was found impossible to heave up the cable. But what ought to have been the feeling of thankfulness to that Providence which regulates and appoints the lot

of man, when it is considered that if this accident had happened during the storm, or in the night after the wind had shifted, the floating light must inevitably have gone ashore upon the Bell Rock. In short, it is hardly possible to conceive any case more awfully distressing than our situation would have been, or one more disastrous to the important undertaking in which we were engaged."

The Beacon or Barrack, which was afterwards erected on the rock as a substitute for the floating light, was inhabited by Mr Stevenson and twenty-eight men. It was a singular habitation, somewhat resembling a pigeon-house, perched on logs, on which the tide rose sixteen feet in calm weather, and was exposed to the assault of every wave. Of the perils and discomforts of such a habitation, the following passages give a lively picture :—

"This scene" (the sublime appearance of the waves) "he greatly enjoyed while sitting at his window. Each wave approached the Beacon like a vast scroll unfolding, and in passing discharged a quantity of air which he not only distinctly felt, but was even sufficient to lift the leaves of a book which lay before him. . . .

"The gale continues with unabated violence to-day, and the sprays rise to a still greater height, having been carried over the masonry of the building, or about 90 feet above the level of the sea. At four o'clock this morning it was breaking into the cook's berth (on the Beacon), when he rang the alarm-bell, and all hands turned out to attend to their personal safety. The floor of the smith's or mortar gallery was now completely burst up by the force of the sea, when the whole of the deals and the remaining articles upon the floor were swept away, such as the cast-iron mortar-tubs, the iron hearth of the forge, the smith's bellows, and even his anvil, were thrown down upon the rock. The boarding of the cook-house, or storey above the smith's gallery, was also partly carried away, and the brick and plaster work of the fireplace shaken and loosened. It was observed during this gale that the beacon-house had a good deal of tremor, but none of that 'twisting motion,' occasionally felt and complained of before the additional wooden struts were set up

for the security of the principal beams ; but this effect had more especially disappeared ever since the attachment of the great horizontal iron bars in connection with these supports, instead of the chain-braces shown in Plate VIII. Before the tide rose to its full height to-day, some of the artificers passed along the bridge into the lighthouse, to observe the effects of the sea upon it, and they reported that they had felt a slight tremulous motion in the building when great seas struck it in a certain direction about high-water mark. On this occasion the sprays were again observed to wet the balcony, and even to come over the parapet wall into the interior of the light-room. In this state of the weather, Captain Wilson and the crew of the 'Floating Light' were much alarmed for the safety of the artificers upon the rock, especially when they observed with a telescope that the floor of the smith's gallery had been carried away, and that the triangular cast-iron sheer-crane was broken down. It was quite impossible, however, to do anything for their relief until the gale should take off. . . .

"The writer's cabin measured not more than 4 feet 3 inches in breadth on the floor ; and though, from the oblique direction of the beams of the Beacon it widened towards the top, yet it did not admit of the full extension of his arms when he stood on the floor ; while its length was little more than sufficient for suspending a cot-bed during the night, calculated for being triced up to the roof during the day, which left free room for the admission of occasional visitants. His folding-table was attached with hinges immediately under the small window of the apartment ; and his books, barometer, thermometer, portmanteau, and two or three camp-stools, formed the bulk of his movables. His diet being plain, the paraphernalia of the table were proportionately simple ; though everything had the appearance of comfort and even of neatness, the walls being covered with green cloth, formed into panels with red tape, and his bed festooned with curtains of yellow cotton stuff. If, on speculating on the abstract wants of man in such a state of exclusion, one were reduced to a single book, the sacred volume, whether considered for the striking diversity of its story, the morality of its doctrine, or the important truths of its Gospel, would have proved by far the greatest treasure."

The great merit due to Mr Stevenson, as the architect of the Bell Rock Lighthouse, lies in his bold conception of, and confident unshaken belief in, the possibility of

executing a tower of masonry on the Bell Rock, which being left dry only at very low tides, and covered at high water to the depth of sixteen feet, obviously presented much greater difficulty than the Eddystone. But his mechanical skill in carrying on the work is also deserving of high praise. Not only did he conceive the plan of the *jib* and *balance cranes*—which he applied, with much advantage, in the erection of the tower—but his zeal, ever alive to the possibility of improving on the conceptions of his great master, Smeaton, led him to introduce some very advantageous changes in the arrangements of the masonry of the tower ; and, in particular, as described below, he converted the floors of the apartments into conservative ties, while in the Eddystone they exert an outward thrust, which the architect counteracted by metallic chains imbedded in a groove filled with molten lead.

“ The floor-courses of the Bell Rock Lighthouse lay horizontally upon the walls, as will be seen from the sections in Plates VII. and XVI. They consisted in all of eighteen blocks, but only sixteen were laid in the first instance, as the centre stones were necessarily left out, to allow the shaft of the balance-crane to pass through the several apartments of the building. In the same manner also the stone which formed the interior side of the man-hole was not laid till after the centre stone was in its place and the masonry of the walls completed. The number of stones above alluded to are independently of the sixteen joggle pieces with which the principal blocks of the floors were connected, as shown in the diagrams of Plates VII. and XIII. The floors of the Eddystone Lighthouse, on the contrary, were constructed of an arch form, and the haunches of the arches bound with chains, to prevent their pressing outward to the injury of the walls. In this, Mr Smeaton followed the construction of the dome of St Paul’s ; and this mode might also be found necessary at

the Eddystone, from the want of stones in one length to form the outward wall and floor, in the then state of the granite quarries of Cornwall. At Mylnefield quarry, however, there was no difficulty in procuring stones of the requisite dimensions ; and the writer foresaw many advantages that would arise from having the stones of the floors to form part of the outward walls without introducing the system of arching. In particular, the pressure of the floors upon the walls would thus be perpendicular ; for as the stones were prepared in the sides with *groove and feather*, after the manner of the common house-floor, they would, by this means, form so many girths, binding the exterior walls together, as will be understood by examining the diagrams and section of Plate VII., with its letterpress description ; agreeably to which, he had modelled the floors in his original designs for the Bell Rock, which were laid before the Lighthouse Board in the year 1800."

The Commissioners entertained a high sense of my father's services at the Bell Rock Lighthouse ; and as many of them took a deep interest in the whole of that remarkable work, and paid occasional visits to it during its progress, they were well able to appreciate the ability and zeal with which he devoted himself to this arduous task. It was moved by the late Sir William Rae, Baronet, then Lord Advocate of Scotland, at a meeting held in the lighthouse itself on the 19th July 1824—" That a bust of Mr Robert Stevenson be obtained and placed in the library of the Bell Rock Lighthouse, in testimony of the sense entertained by the Commissioners of his distinguished talent and indefatigable zeal in the erection of that lighthouse." A beautiful bust, in marble, by Samuel Joseph, from which the plate prefixed to this memoir was taken, was accordingly placed in the library of the lighthouse. From its striking resemblance, it recalls in

a very pleasing manner the memory of my father, coupled with many of his counsels delivered on the spot during my frequent visits to the Bell Rock in his company.

It appears, from the minutes of the Commissioners, that my father performed his first tour of inspection of the lighthouses, and made the Annual Report to the Board, in the year 1797. During the long period of his incumbency which followed, he designed and executed twenty-three lighthouses in the district of the Commission, many of them in situations which called for much forethought and great energy. All his works were characterised by the same sagacity and comprehensive views, and exhibit successive stages of improvement, equally indicative of the growing prosperity of the Board, and the alacrity and zeal with which their engineer laboured in his vocation. In no country has the *Catoptric* system of illuminating lighthouses been brought to so high a degree of perfection as in Scotland; and in consequence of information which he received from Colonel Colby, of the invention of the *Dioptric* light by Fresnel, my father was the first to bring the merits of that system before the Commissioners of Northern Lighthouses, in his Report of December 1821. Whether we consider the accuracy and beauty of the optical apparatus, the arrangements of the buildings, or the discipline observed by the light-keepers of the Northern Lighthouses, we cannot fail to recognise the impress of that energetic and comprehensive cast of mind which directed the whole. With the strictest propriety my father may be said to have created and perfected the lighthouse

system of Scotland. His merits indeed, in this respect, were generally acknowledged in other quarters; and many of the Irish lighthouses, and several lighthouses in our colonies, were fitted up with apparatus prepared under his superintendence. While writing on this subject, I can hardly omit to quote the opinion of the Astronomer-Royal, formed after having inspected lighthouses, both in this country and in France. Mr Airey says, in his Report to the Royal Commission on Lighthouses, dated October 10, 1860 :—"This lighthouse (Girdleness, in Aberdeenshire) contains two systems of lights. The lower, at about two-fifths the height of the building, consists of thirteen parabolic reflectors, of the usual form. I remarked in these that, by a simple construction which I have not seen elsewhere, great facility is given for the withdrawal and safe return of the lamps, for adjusting the lamps, and cleaning the mirrors;" and, in closing his Report, he adds, "It is the best lighthouse that I have seen." In the course of his labours as engineer to the Lighthouse Board, my father's attention was much given to the subject of distinction among lights, a matter of the utmost importance in narrow seas, where many lights are required. He was the inventor of two useful distinctions—the *intermittent* and *flashing* lights, for the latter of which he received from the late King of the Netherlands a gold medal, as a mark of his Majesty's approbation. In the first of those distinctions the light is suddenly obscured and as suddenly revealed to sight, at unequal intervals of time, in



a manner which completely distinguishes it from the ordinary revolving light, which from darkness *gradually* increases in power till it reaches its brightest phase, and then gradually declines until it is again obscured. The flashing light exhibits, by means of a rapid revolution of the frame which carries the lamps, and a peculiar arrangement in their position, a sudden flash of great power, once in five seconds of time.

Besides his official duties as engineer to the Light-house Board, he took a large share in the general engineering of his day, and acted on many occasions in conjunction with Rennie, Nimmo, Telford, and afterwards with Walker and Cubitt, with all of whom he ever maintained a friendly intercourse. Soon after the peace in 1815 the public mind was naturally directed to the improvement of our internal resources, which the long continuance of the Continental war had thrown unduly into the shade. Roads, bridges, harbours, canals, and railways, soon became topics of public attention and general interest; and my father's known sagacity and energy rendered him a useful adviser on many of those subjects. In the course of his professional life he designed and executed several important bridges, such as those of Stirling, Marykirk, Annan, and the Hutcheson Bridge over the Clyde at Glasgow. Of the latter, Mr Fenwick, of the Royal Military Academy, Woolwich, in the preface to his work on the *Mechanics of Construction*, published in 1861, says:—"The London and Waterloo bridges in the metropolis, which rank

among the finest structures of the *elliptical arch*, and Stevenson's Hutcheson Bridge at Glasgow, which is one of the best specimens of the *segmental arch*, together with many others, have supplied me with a variety of problems for illustration." In 1826 he gave a design to the corporation of Newcastle for raising on the existing bridge another roadway, on a high level, to communicate with the higher parts of the town ; being the very idea since so successfully carried out by the late Mr Robert Stephenson in his justly celebrated "high-level railway viaduct."

The beautiful approaches to the City of Edinburgh from the east, by the Calton Hill, known as the London and Regent Roads, were designed by my father, and executed under his direction ; and I mention this the more willingly, as it seems difficult to conceive anything finer than the splendid entrance by the High School and Jail, to what Sir Walter Scott has called "our own romantic town." \* He also surveyed and traced the lines of many canals and railways, which

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\* The foundation stone of the Regent's Bridge, which was designed by Mr Elliot, contains a plate of platinum, on which the following is inscribed :—

Regnante Georgio III. Patre Patriæ  
 Urbis præfecto iterum  
 Joanne Marchbanks de Lees equite baronetto  
 Architecto Roberto Stephenson  
 Cives Edinburgenses  
 Novum hunc et magnificum  
 Per montem vicinum  
 Ad summam urbem aditum moliti  
 In hoc ponte nomen jusserunt inscribi  
 Proregis Georgii Augusti Frederici.

have since been executed, more or less, in accordance with the advice contained in his numerous printed reports. We may especially mention his projected canal, and afterwards railway, *on one level*, between Edinburgh and Glasgow; his great Strathmore Canal and Railway, on one level, which would have connected the towns of Perth, Forfar, Arbroath, Montrose, and Brechin, and his railway from Stockton to Darlington. In 1818 the Highland Society of Scotland offered a premium of fifty guineas for the best essay on the construction of railroads. Many competing treatises were given in, and the Society placed the whole of them in the hands of my father for his opinion and report on their merits, "together with such remarks of his own as he might judge useful." The result of his examination is given at great length in the Transactions of the Society,\* accompanied by "notes," in which he makes several valuable suggestions. Before the period alluded to, the rails in use had been almost invariably made of cast-iron or timber; but my father, in his notes, says,—“I have no hesitation in giving a decided preference to malleable iron, formed into bars from twelve to twenty feet in length, with flat sides and parallel edges, or *in the simple state in which they come from the rolling mills of the manufacturer.*” He also recommends that they should

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\* The essays most favourably noticed are those of Mr Alexander Scott, Mr George Robertson, Mr George Douglas, Mr John Ruthven, Mr James Dickson, Mr James Walker (Carron), Mr James Walker (Lauriston), Mr John Fraser, Mr John Wotherspoon, Mr John Moore, and Mr John Baird.

be fixed into guides or chairs of iron, supported on props placed at distances in no case exceeding three feet, and that they should be connected with a clamp-joint, so as to preserve the whole strength of the material. It is not a little singular that this description, given about forty years ago, may, to use engineering phraseology, be not inaptly called a "specification of the permanent way" of our best railways at the present day. The following letter, written in 1821, shows the value which Mr George Stephenson, who has been justly styled the pioneer of railway engineers, attached to my father's suggestions, while it is, at the same time, interesting, as showing the very moderate estimate which the great railway engineer then entertained of the performance of the locomotive engine—a machine which was destined afterwards in his hands to become so important in changing the inland communication of the whole civilised world :—

KILLINGWORTH COLLIERY,  
*June 28, 1821.*

ROBERT STEVENSON, Esq.

SIR,—With this you will receive 3 copies of a specification of a patent malleable-iron rail invented by John Birkinshaw of Bedlington, near Morpeth. The hints were got from your Report on Railways, which you were so kind as to send me by favour of Mr Cookson some time ago. Your reference to Tindale-fell Railway led the inventor to make some experiments on malleable-iron bars, the result of which convinced him of the superiority of the malleable over the cast iron—so much so, that he took out a patent. Those rails are so much liked in this neighbourhood, that I think in a short time they will do away the cast-iron railways. They make a fine line for our engines, as there are so few joints compared with the other. I have lately started a new locomotive engine, with some improvements on the others which you saw :

it has far surpassed my expectations. I am confident a railway on which my engines can work is far superior to a *canal*. On a long and favourable railway I would stent my engines to travel 60 miles per day with from 40 to 60 tons of goods. They would work nearly fourfold cheaper than horses where coals are not very costly. I merely make these observations, as I know you have been at more trouble than any man I know of in searching into the utility of railways; and I return you my sincere thanks for your favour by Mr Cookson.

If you should be in this neighbourhood, I hope you would not pass Killingworth Colliery, as I should be extremely glad if you could spend a day or two with me.—I am, sir, yours most respectfully,

(Signed) G. STEPHENSON.

In the same notes my father also suggests a new form of stone tracks used for easing the draught on common roads. Specimens of it were laid down under his direction on the South Bridge and Pleasance, and a sample of it may be seen at Liberton hill, near Edinburgh. Within the last few years it has been proposed to lay such stone tracks on several of the turnpike roads throughout the country.

In 1825 he proposed a form of suspension bridge, applicable to small spans, in which the roadway passes *above* the chains, and the necessity for tall piers is avoided. The Suspension Bridge over the Rhone at Geneva, and other bridges, have been constructed on this principle. For timber bridges he also proposed a new form of arch of a beautiful and simple construction, in which what might be called the ring-courses of the arch are formed of layers of thin planks bent into the circular form and stiffened by *king-post pieces*, on which the level roadway rests. This form of bridge has since come

into very general use on railways. His proposal to adopt the cycloidal curve for the vertical profiles of sea-walls, which he carried into execution at Trinity, near Edinburgh, and his design for securing *constant motion*, by causing the hydrostatic pressure of the varying level of the tide to toll a bell, as a warning signal for the Carr Rock Beacon, are further instances of the inventive turn of his mind.

There is scarcely a harbour or a navigation in Scotland about which at some time he did not give valuable advice ; and he was also often consulted in England and Ireland—on the Severn, Mersey, Dee, Wear, Tees, Erne, and other rivers and harbours. His published reports and contributions to engineering knowledge extend, when collected, to four thick quarto volumes ; and during his long life of industry he did much which, like a large portion of the labours of all professional men, was never known beyond the sphere immediately affected by it.

In addition to his professional exertions, he took an active part in advancing the interests of science in so far as lay in his power, and was one of the original promoters of the Astronomical Institution, out of which has grown the present establishment of the Royal Observatory. In 1815 he became a Fellow of the Royal Society of Edinburgh ; and he afterwards joined the Geological Society of London, and the Wernerian and Antiquarian Societies of Scotland. In 1816 he published his memoir on the alveus or bed of the German Ocean, in which he showed, by an appeal to many evidences, that

the sea was gradually encroaching on the land, and that the sand-banks in the German Ocean are the result of the degradation of the adjoining shores. In this memoir, which has been quoted by Lyell, Cuvier, and others, he estimates the sand-banks in the German Ocean as equal to the cubic contents of a stratum of that sea fourteen feet in thickness. In the year 1812, while engaged on the Dee at Aberdeen, in making certain observations under a remit from the Court of Session, he discovered the interesting fact, which has since become so well known, that the salt water of the ocean flows up the beds of rivers in a stream quite distinct from the outflowing fresh water, which, owing to its smaller specific gravity, floats on the surface. In order to test the truth of his hypothesis, he had an instrument hastily fitted up by an optician in Aberdeen, by which he found that while the water on the surface was fresh, that raised from the bottom was perfectly salt. This instrument, now termed a hydrophore, is often employed in engineering and scientific inquiries for drawing specimens of water from different depths in rivers and estuaries. He also made several contributions to the *Encyclopædia Britannica*, to the *Edinburgh Encyclopædia*, and to various scientific journals of the day; and gave (in a series of Letters which appeared in the *Scots Magazine* in 1817) a lively and instructive account of a tour through the Netherlands, in which he described some of the most interesting engineering works connected with the drainage and embankment of Holland.

Sagacity, fortitude, and perseverance were very prominent points of Mr Stevenson's character. In private life he was a man of sterling worth ; and whether we regard him as a husband, a father, or a friend, he was equally distinguished by the absence of selfishness and by his great generosity. His exertions in forwarding the progress of young men through life were extensive and unwearied ; and few men had more solid grounds than he for indulging in the pleasing reflection that, both in his public and private capacity, he had consecrated to beneficial ends every talent committed to his trust. Many of his personal friends have recorded the pleasant satisfaction with which they continued through life to look back upon the days spent in Mr Stevenson's company on board the lighthouse tender, on the occasion of his making his annual inspection of the lighthouses. On one of those voyages made in 1814 he was accompanied by Sir Walter Scott, who has given a graphic description of it in his autobiography, from which I shall quote a single passage, giving an amusing account of the first landing made by the Commissioners on the rock on which the Skerryvore lighthouse has since been erected.\*

"Having crept upon deck about four in the morning," says Sir Walter, "I find we are beating to windward off the Isle of Tyree, with the determination, on the part of Mr Stevenson, that his constituents should visit a reef of rocks called Skerry Vhor, where he thought it would be essential to have a lighthouse. Loud remonstrances on the part of the Commissioners, who, one and all, declare they will sub-

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\* See LOCKHART'S *Life of Scott*.